

Battlefield Casualties Treated at Camp Rhino, Afghanistan: Lessons Learned

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Background: Operation Enduring Freedom is an effort to combat terrorism after an attack on the United States. The first large-scale troop movement (> 1,300) was made by the U.S. Marines into the country of Afghanistan by establishing Camp Rhino.

Methods: Data were entered into a personal computer at Camp Rhino, using combat casualty collecting software.

Results: Surgical support at Camp Rhino consisted of two surgical teams (12 personnel each), who set up two operating tables in one tent. During the 6-week period, a total of 46 casualties were treated,

and all were a result of blast or blunt injury. One casualty required immediate surgery, two required thoracostomy tube, and the remainder received fracture stabilization or wound care before being transported out of Afghanistan. The casualties received 6 major surgical procedures and 11 minor procedures, which included fracture fixations. There was one killed in action and one expectant patient. The major problem faced was long delay in access to initial surgical care, which was more than 5 hours and 2 hours for two of the casualties.

Conclusion: Smaller, more mobile surgical teams will be needed more frequently in future military operations because of inability to set up current larger surgical facilities, and major problems will include long transport times. Future improvements to the system should emphasize casualty evacuation, en-route care, and joint operations planning between services.

Key Words: Afghanistan, Casualties, Marine, Trauma, Operations, Tent, Surgery, Enduring freedom, Fleet Hospital.

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Operation Enduring Freedom is an effort to combat world terrorism after an attack on the United States. The first large-scale troop movement (> 1,300) was made by the U.S. Marines into the country of Afghanistan by establishing Camp Rhino. Over the last decade, the Marines have adapted a new war-fighting tactic—Expeditionary Maneuver Warfare. This allows them to establish a presence inland, (in theory up to 200 nautical miles) with sea-based logistics and supply. Traditionally, Marines are the first in fight by performing beach assaults and securing the way for future troop movements. Surgical support was either

from a Medical Battalion Surgical Company and/or Fleet Hospital on land or on the Casualty Receiving and Treatment Ships (CRTS) and/or Hospital Ships at sea. The Surgical Companies and Fleet Hospitals are large, heavy, and logistically demanding. With these modern warfare tactics and the ever-changing nonlinear battlefield, the medical/surgical support for the Marines had to adapt. Time from wounding to surgical care is simply too long and the evacuation situations can be unpredictable. Therefore, recent doctrine allows for small surgical teams to establish a forward surgical presence, thus providing life- and limb-sparing surgery closer to the anticipated battle zone. This surgical presence needs to be light and mobile (i.e., able to move personnel and equipment within 1 hour). The CRTSs and Surgical Companies at sea remain for follow-on care.

Camp Rhino was an extreme example of Expeditionary Maneuver Warfare, as it was located 400 miles inland, in southern Afghanistan, and had sea-based logistics and supply on the 15th and 26th Marine Expeditionary Units (MEUs), located in the Arabian Sea. Because of the distances from sea-based surgical support, the first modern example of the Marine Corps' small forward surgical capability was established at Camp Rhino. Strategically, this placed surgical capability within 1 to 2 hours of wounding. Conditions at Camp Rhino were austere and logistically difficult. The medical facility was set up to include a Battalion Aid Station (BAS) and a Shock Trauma Platoon (STP), providing resuscitation and stabilization capabilities as well as an operating room (OR) section, providing surgical capability. The nature of the

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The opinions and conclusions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the United States Marine Corps, United States Navy, or the Department of Defense.

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Table 1 Medical Detachment Personnel at Camp Rhino

Medical Personnel	1st Medical BN	2nd Medical BN	15th MEU HSS	Total
General surgeon	1	1		2
Anesthesiologist	1	1		2
Emergency physician	2		1	3
General medical officer			1	1
Emergency nurse	2			2
Critical care nurse	1			1
Perioperative nurse	1			1
Physician assistant	1			1
Medical regulator			1	1
Independent duty corpsman	1			1
Operating room technician	2		1	3
General duty corpsman			14	14
Total				32

HSS, Health Service Support for the 15th Marine Expeditionary Unit; BN, battalion.

casualties, their care, and lessons learned from this experience are discussed.

MATERIALS AND METHODS

From November 25, 2001, to January 3, 2002, medical personnel set up a receiving and stabilization area with surgical capabilities. Data were collected by review of records at Camp Rhino and receiving facilities. Interview of key personnel was undertaken, and data recorded at Camp Rhino were collected into a personal computer using the International Early Conflict Database devised by the Center for Healthcare, Education, and Studies. This early collection of data allowed the information to be gathered while recollection of the occurrence was relatively fresh. On return to the United States, data were confirmed by interviewing personnel who also received the patients for further care on the Casualty Receiving Ships.

RESULTS

Trauma resuscitations and surgical care at Rhino were rendered by 1st Medical Battalion's STP and OR section joined by the surgeon and anesthesiologist from 2nd Medical Battalion, and the Health Service Support Detachment from the 15th MEU. These personnel and makeup are listed in Table 1. USS PELELIU and USS BATAAN were the CRTSs in the Arabian Sea supporting this mission. The U.S. Air Force (USAF) Theater Hospital in Seeb, Oman, was the Echelon III (subspecialty) surgical capability in theater.

The STP was set up in an abandoned warehouse that had intact roof and walls. Temperature control was maintained using a kerosene stove, as the temperatures ranged from the mid 30s (Fahrenheit) during the night to the 60s during the midday. Electricity was available through the use of field generators. STP equipment included Impact 754 (Univent) Ventilators, Impact Portable Suction, and Propaq monitors. Fluid was warmed using a small microwave oven and blood was refrigerated using a field reefer. Packed red blood cells



Fig. 1. Camp Rhino medical personnel and support staff.

were obtained in theater from USS PELELIU. Additional capability to draw and transfuse fresh whole blood from the "walking blood bank" was present. The STP was equipped with enough consumable items to perform 100 resuscitations/stabilizations. No radiologic or laboratory capability was present.

The MEU Health Service Support Detachment personnel manned the BAS and contributed to the STP. It consisted of a general medical officer, a medical service corp officer, and 14 corpsman. Additional medical personnel in theater included a senior flight surgeon whose background was emergency medicine, and he acted as the senior medical officer in the field (Fig. 1). The supplies and equipment for all eight required pallets (USAF 63-L) weighed approximately 36,000 lb.

The operating room was set up in a Drash-5 Tent (approximately 350 sq ft), with liner and flooring immediately adjacent to the warehouse serving as the BAS/STP (Fig. 2). Internal temperature control was attempted using a portable heater (USMC BOO5 ECU). The total OR personnel consisted of two general surgeons, two anesthesiologists, and three OR technicians. The OR equipment included two Narcomed Anesthesia Machines with draw-over vaporizers as backup, two field OR tables, two Bovie machines, fiberoptic headlamps, and Propaq monitors. Oxygen was supplied by large H-cylinder tanks. A field steam sterilizer was also available. Sufficient consumables were available to perform approximately 50 surgical cases. Initial guidance by the commanding officer at Camp Rhino was to set up medical facilities to receive up to 6 to 10 casualties per day.

During the 6-week period, three separate events caused a total of 48 casualties that were treated at Camp Rhino. All were a result of "friendly fire" blast or blunt injury. The first event occurred on December 5, 2001, 1 day after the STP and OR areas were set up. This was the result of an errant Joint Defense Attack Munition (JDAM) bomb drop, injuring 21 U.S. serviceman and 20 friendly Afghanistan nationals. After the event, the injured personnel requested air evacuation and the transporting helicopters were summoned from Camp Rhino and elsewhere. Because of the distances to the inci-

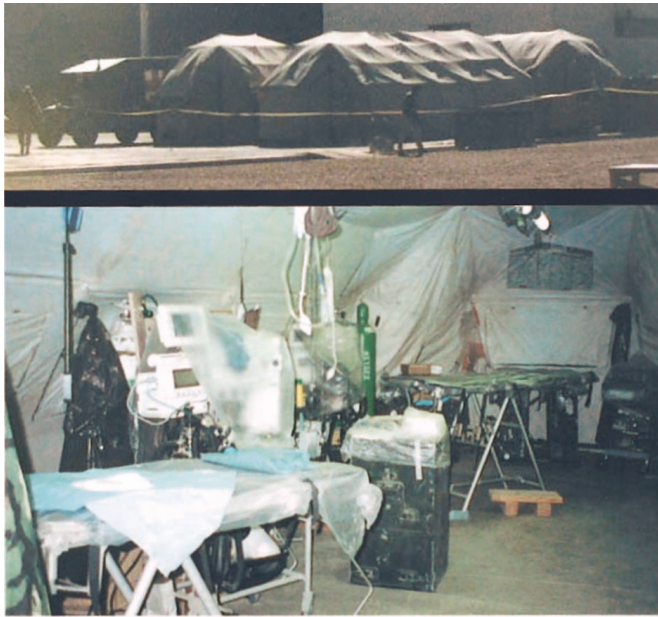


Fig. 2. (Top) Camp Rhino medical area showing the tents containing the OR and BAS and the warehouse that housed the STP. (Bottom) Setup of the OR inside the tent.

dent, the time to scene of injury was estimated to be approximately 2 to 3 hours. Transportation from the scene to Camp Rhino was an additional 2 to 3 hours. Injury was estimated to have occurred at approximately 0900 local time, and the time that the first casualty arrived at Camp Rhino was approximately 1400 local time. The delay in casualty evacuation was the result of the loss of communications with the ground personnel, the lack of security in the area, and aircraft mechanical delays.

Initial reports of the casualty numbers ranged from 4 to 40 injured. Because of this report, arrangements were made by the special operations medical sources in theater to take some of the casualties directly to Seeb, the U.S. Air Force theater hospital in Oman, from the Camp Rhino airfield. Because of the political situation, a decision was made by commanding officers in theater that only U.S. personnel could be transported to Seeb and that Camp Rhino medical personnel would treat the Afghanistan nationals.

This mass casualty resulted in the transport of 41 injured persons to Camp Rhino. On arrival to the Camp Rhino airfield, 19 injured U.S. personnel were immediately taken directly to Seeb. The remaining 2 Americans and 20 Afghanistan nationals were treated and stabilized at Camp Rhino (Fig. 3). These injured were transported to the BAS/STP area from the landing zone (approximately 2,000 meters away) by ground transport.

Forty-one patients sustained 82 injuries. The distribution of injuries from the data collected is outlined in Table 2. No data were available for four patients. Twenty-seven patients sustained injuries to multiple anatomic areas. As expected, the majority of injuries were located on the extremities



Fig. 3. Treatment of JDAM bomb casualties in the STP.

(53.6%). A significant number of injuries were also seen on the head/face region (25.6%). Fragment and blast mechanisms were responsible for the majority of injuries (63.4% and 17.1%, respectively). Of the blast injuries, the majority were tympanic membrane ruptures, with none identified as having lung or intestinal blast sequelae. Only four burn injuries were identified—a flash burn to the eyes, and deep partial-thickness burns to the chest and also to bilateral lower extremities. Of note, there were no injuries to the genitalia.

Extremity injuries are detailed further in Table 3. The majority of injuries were minor and required only mild debridement and wound care (20.4% upper extremity and 27.3% lower extremity). The majority of fractures sustained were open, eight of nine, and the majority of these were in the upper extremities (six of the eight). There were three amputations (one below the knee for a mangled extremity) and two upper extremity amputations (one below the elbow and one above). Unfortunately, the upper extremity amputations were both in the same patient. There were two vascular injuries, one to the brachial artery and one to the superficial femoral artery. The latter sustained a pseudoaneurysm secondary to a shrapnel fragment and was repaired with a polytetrafluoroethylene interposition graft on the casualty receiving ship.

Focusing on only those remaining at Rhino, one U.S. servicemen was deemed expectant with an irreversible open head injury and one was killed in action, having been dismembered. Of the 20 injured Afghanistan nationals treated, one required immediate surgery to evaluate a shrapnel injury to the neck and jaw. The patient was intubated, the neck was explored, and it was quickly determined that there was no significant vascular injury. The wound was packed and arrangements were made for immediate transfer to the CRTS in the Arabian Sea. Of the remaining 19 casualties, 2 required chest tubes on the basis of clinical suspicion. One patient was in shock, with small chest shrapnel and subcutaneous emphysema, and the other had diminished breath sounds with shrap-

Table 2 Distribution of Injuries for JDAM Bomb Drop by Anatomic Location*

Anatomic Area	Blast	Fragments	Blunt	Burn	Total (%)
Head/face	12	7	1	1	21 (25.6)
Penetrating		2	0		2 (2.4)
Neck		1	1		2 (2.4)
Penetrating		3	0		3 (3.6)
Thorax/back		2	1	1	4 (4.9)
Penetrating		3	0		3 (3.6)
Abdomen		1	1		2 (2.4)
Penetrating		1	0		1 (1.2)
Extremities	3	32	7	2	44 (53.6)
Total (%)	15 (18.3)	52 (63.4)	11 (13.4)	4 (4.9)	82

* Injuries of the head, neck, chest, and abdomen are classified as penetrating if they violated the skull, platysma, chest cavity, or peritoneum, respectively.

nel injuries to the chest wall. Six others had open fractures and received bedside irrigation, dressings, and splinting. The remainder were deemed to have superficial/minor injuries. After initial treatment and stabilization, all 20 of the injured, including the postoperative patient, were ground-transported to the airfield and onto helicopters, which took the patients to the CRTSs. Transportation to the CRTSs was estimated to be approximately 4 to 5 hours. This time delay was because of a mechanical problem with one of the aircraft and because the CH-53 helicopters used for transport required in-flight refueling to make the trip to the ships.

Two CRTSs in theater off the shores of Pakistan received 10 injured Afghanistan nationals each. There, additional treatment was given, including multiple surgeries. Each CRTS had two functional operating rooms and an augmented Fleet Surgical Team. USS PELELIU had one general sur-

geon, one orthopedic surgeon, and one obstetrician/gynecologist. USS BATAAN had one general surgeon and one ear, nose, and throat specialist. The CRTS had radiographic and laboratory capability and 600 units of frozen blood available.

The second event was a helicopter crash (Fig. 4) at Camp Rhino on December 6, 2001, which resulted in four injuries, all of which were minor. Two suffered corneal abrasions and two suffered soft tissue injuries and lacerations. No surgery was required in these patients.

December 16, 2001, brought the third casualty event, as an antipersonnel land mine explosion resulted in three injured U.S. Marines at Kandahar Airfield. Although the 26th MEU and the 2nd Medical Battalion medical/surgical team were located there, the facility was not yet set up to take casualties, thus these Marines were evacuated to Camp Rhino and then on to Seeb. One of the injured had a near complete amputation of the lower leg, treated with a tourniquet. One suffered a degloving injury to the hand, and the other suffered a ruptured tympanic membrane with some soft tissue injuries. On arrival to Camp Rhino (approximately 1.5 hours from the time of injury), the patients were evaluated by the camp senior medical director. The casualty with the partial amputation was sent directly to Seeb without being treated at Camp Rhino. The other two were ground-transported to the STP. The individual with the hand degloving injury received operative debridement and exploration with irrigation. The ca-

Table 3 Extremity Injuries

Injury	No. (%)
Soft tissue injury (minor)	
Upper extremity	9 (20.4)
Lower extremity	12 (27.3)
Soft tissue injury (major)*	
Upper extremity	3 (6.8)
Lower extremity	4 (9.1)
Vascular injury	
Upper extremity	1 (2.3)
Lower extremity	1 (2.3)
Burns	
Upper extremity	0 (0)
Lower extremity	2 (4.5)
Open fracture	
Upper extremity	6 (13.6)
Lower extremity	2 (4.5)
Closed fracture	
Upper extremity	1 (2.3)
Lower extremity	0 (0)
Amputation	
Upper extremity	2 (4.5)
Lower extremity	1 (2.3)
Total	44 (100)

* Major soft tissue injuries were classified as those needing operative debridement.

**Fig. 4.** Remains of helicopter (UH-1) crash at Rhino.

casualty with the partial amputation eventually underwent a below-knee amputation.

DISCUSSION

Injuries seen and treated at Camp Rhino were only slightly different from those of prior conflicts. The differences were probably related to the lack of pure small arms combat during this time. In addition, our data reflect that the Afghani casualties were not wearing body armor. The majority of injuries were minor and from blunt or blast mechanisms, with penetrating injuries only resulting from shrapnel or flying debris. As expected, there were no bullet wounds to speak of. Only one casualty was classified as "died of wounds," and this American Special Operations Force serviceman suffered a penetrating head injury, presenting to Camp Rhino agonal with fixed, dilated pupils. Looking at the data from the bomb drop, some notable differences include the percentage of head and neck injuries seen at Rhino, 28%, whereas the rate was only 9.9% in Somalia.¹ Extremity injuries constituted 53.6% of the injuries at Rhino as compared with 74.7% in Somalia.¹ This difference may be attributable to the Afghanistan nationals not wearing body armor. The Somalia data seem to correlate with data from Vietnam, where armed conflict was responsible for the majority of injuries.¹

There were interesting differences in the wounding between the Afghani patients and the American patients. Most notable is the difference in the number of tympanic membrane ruptures. There were nine U.S. patients and only one Afghani national who suffered this injury. This difference could be caused by a number of factors. Proximity to the blast could account for the dichotomy; however, it was not determined whether the U.S. servicemen were closer to the blast than the Afghanis. If this was the case, the U.S. servicemen did not suffer any higher rate of other blast injuries. The language barrier led to some delay in the Afghani patients expressing complaints, whereas the U.S. patients were much more likely to complain of being unable to hear. It was only after a translator was obtained on one of the ships that the one Afghani complained of being unable to hear. Almost all the Afghanis also had cerumen impaction bilaterally, whereas most of the Americans did not. One could speculate that the cerumen provided some form of protective barrier to the blast.

Another interesting observation was the incredible pain tolerance of the Afghani patients. Only a minimal amount of local anesthetic was necessary to place chest tubes and perform wound irrigations that were largely unopposed. Each Afghani man (there were no women in this group of injured) had on his person a small tin of poppy seeds. This may account for the pain tolerance.

The Afghani patients were also noted to be profoundly dehydrated. On questioning, these men ate one meal every 2 to 3 days on average and largely drank contaminated water. Most of them had barely palpable distal pulses, which were

easily detected after fluid boluses. Many patients did not have significant blood losses to account for this, and this inherent dehydrated status may have been the reason several of them were able to withstand the long evacuation time to Rhino. The patient with the shrapnel wound to the neck, for example, began to lose his airway shortly after a small amount of fluid was infused and on operative exploration was noted to rapidly develop laryngeal edema. The patient treated with the femoral artery pseudoaneurysm did not begin to show thigh enlargement until a small fluid bolus was given and the shrapnel wounds on his leg began to bleed.

Mine injuries must be mentioned, as Afghanistan has one of the highest concentrations of land mines per square kilometer. Should conflicts continue in such areas as Afghanistan, mine injuries will inevitably become more frequent, and this is an injury with which most of our current military medical personnel are unfamiliar. Training for these types of injuries and injury patterns remains difficult.

One problem that may account for the differences in data are the poor ability to record data. Although many new field medical systems will have personal computers, for the Rhino personnel, computer use was not abundantly available. In addition, there remains no military trauma registry. The database used was brought to Rhino after the casualty incidents had taken place, and so data were unable to be entered at time of care. This led to inherent inaccuracies, as patient charts had left the base and data had to be retrieved from the receiving facilities. A military trauma registry and user-friendly casualty recording database needs to be established to improve data reporting and, subsequently, lessons learned.

Despite the fact that Camp Rhino was set up strategically to receive casualties within 1 to 2 hours of wounding, the casualty evacuation (from point of wounding to a medical/surgical facility) time from the JDAM bomb drop site was 4 to 5 hours. Safety and security issues and mobility issues prohibited the medical/surgical facility from moving any closer to the point of wounding. This, in addition to the communication difficulties encountered, hindered the evacuation times further. Another problem encountered by the physician and corpsman performing the casualty evacuation mission was the inability to tell "friend" from "foe" except for the American servicemen in uniform. The Afghanistan opposition group fighters (mostly Northern Alliance members) were in their native garb—not in uniform—and the Taliban members were not dressed any differently. Those on this mission raised a question as to how to identify "who was who." Fortunately, those in that immediate area who were evacuated were identified as Karzai's fighters and no Taliban members were in this group. When military medical/surgical teams are out with these small, mobile detachments, one must ask how well these individuals should be trained in combat skills. Specialists and subspecialists have not traditionally been put in position to be this far forward, and if done so, are with a large security force. When the teams get smaller, it calls for all team members to be highly trained and cross-

trained. The U.S. Navy, as yet, does not do this, to an adequate extent for its medical personnel.

The issue of small, short, and intense conflicts raises many concerns with regard to the training of military medical personnel. First and foremost is the lack of the affordable “learning curve.” When conflicts end within 4 to 6 or even 8 weeks and involve only a few waves of casualties, there is no time to “learn the system.” Teams must be deployed together, having trained medically and operationally together. This then begs the question of what kind of training is necessary. As mentioned above, combat operational training is absolutely necessary and is being developed into a course entitled the Combat Survival Skills Course. Currently, it is in the pilot phase.

Trauma-specific training is paramount to the armamentarium of those in these small teams. The U.S. Navy does not have any Level I trauma centers in its system; therefore, during peacetime, there is no active participation in trauma care. To date, ongoing trauma sustainment training has been done through personal moonlighting or through a 1-month rotation at a now-closed Joint Trauma Training Center. Each branch of the U.S. military has opened a training center at one of our nation’s Level I trauma centers. The Navy has recently opened its Naval Trauma Training Center at the Los Angeles County/University of Southern California Hospital. Here, teams of medical personnel including surgeons, nurses, anesthesia providers, physician assistants, and corpsman will spend approximately 30 days every 18 to 24 months in a trauma rotation. One must now ask the question, is this duration and frequency adequate to maintain the skills necessary to provide proper care of these injured servicemen?

The next phase of training that is absolutely called for is joint service training. The Navy medical personnel at Rhino worked very closely with the U.S. Air Force and with several other allied forces. It would be prudent to exercise with other services and those of our allies to alleviate many questions. It is necessary for us to know each other’s capabilities and limitations, and a time of war is not the best time to do this. In 1999, COL J.C. Humphrey, USAR, wrote: “the medical communities of all countries need to be prepared to share patients, equipment, expertise and staff.”² This became very apparent at Camp Rhino, and the learning curve for all was exponential.

Although all these improvements are being established, it is up to the leaders of Navy Medicine to see they remain and continually improve. History has taught the Israelis a harsh lesson, and the United States can parallel this lesson on a number of accounts: “After only a short period without any terrorist activities, people tend to forget about the dangers and to question the need for training, exercises and budgets.”²

The conditions under which the medical teams at Rhino worked were relatively severe. There was no running water—all water was bottled and had to be brought in. There was 4.5 L/day of water allotted to each individual and water for the medical facilities was taken out of this pool. The electricity to



Fig. 5. (Top) A view of Camp Rhino showing terrain and camp. (Bottom) Typical dust cloud produced by any aircraft taking off or landing.

support the surgical suite and STP site was from portable generators, and power was shared by all facilities on the camp. Although some heating capabilities were available, overall the temperatures fluctuated considerably. The temperature inside the OR was unable to be brought above 55°F when external temperatures were below 30°F. As Camp Rhino was located in the middle of a dried lake bed, the grounds were arid, and light dust predominated (Fig. 5). In fact, there has been no appreciable rainfall noted in that area for over 4 years. All meals provided were in the form of Meals Ready to Eat (MREs), which are prepackaged meals in plastic bags. These were rationed to all personnel in the camp, and allowed for only two meals per day for a prolonged period. The logistics of the situation were to blame for the majority of these conditions, as everything on the camp had to be brought in by air. It is notable, however, that because the food and water were limited to MREs and bottled water, the incidence of gastrointestinal illness among those in the camp was almost nil. The dust conditions proved a problem with regard to the sanitation of the medical facilities. The shelters used did not allow for “airtight” doors to close, and so twice-daily cleaning was necessary in addition to keeping all equipment covered with plastic when not in use.

Many of the problems outlined above will be at least in part alleviated with the addition of the Marine Corps' Forward Resuscitative Surgical System (FRSS). This is a highly mobile unit created by the Marine Corps Combat Development Center to support Expeditionary Maneuver Warfare. It is a trauma surgical system designed to resuscitate and perform field damage control procedures in the small mobile forward arena for life and limb salvage only. The procedures are designed to be damage control in technique but done for resource limitations rather than patient physiologic exhaustion. For example, field damage control procedures would include maneuvers to control active hemorrhage, reestablish vascular flow, control bowel contamination, and place external fixators. The feasibility of performing damage control procedures on military combat casualties has come into question; however, this conclusion was made on the basis of these procedures being performed on the same type of patients seen and treated in civilian trauma centers.³ Because of the lack of resources in the field, the type of patients who require damage control surgery in civilian trauma centers may be deemed expectant.^{1,4} Adequate intensive care resources simply do not exist in a forward military environment to support such severe casualties. Appropriate triage and mature surgical judgment are the keys to successful selection of patients to undergo these procedures.

The need for a system such as this is not new. Many surgeons experienced in military trauma have written on the subject dating back to World War I and/or have gone so far as to organize and use such "mobile forward surgical units . . . designed to treat urgent wounds, particularly those to the abdomen and chest and those producing profound hemorrhage."⁵ The U.S. Army and U.S. Air Force have versions of forward mobile medical/surgical units that meet their mission requirements. The success of these systems, however, relies on these principles as stated by Mattox, "qualified first responders . . . continuing care during secondary transport, and optimization of practical telemedical technology."⁶

The FRSS uses eight personnel, weighs < 4,000 lb, and can be carried on two 63-L USAF pallets or by one Humvee and one ambulance with two small trailers. This weight and cube will allow it to be transported rapidly by whatever transportation assets are available. It can be set up and ready to take surgical casualties in 40 to 60 minutes by a properly trained team. It can also be packed and ready to relocate in 40 to 60 minutes. The system is set up to take care of 18 casualties without resupply and can sustain continuous operations for 48 hours without relief of personnel. The FRSS is nearing its final stages of approval, and so the system was unable to be used for the Rhino mission. The system itself, with its shelters, equipment, self-sufficiency, and trained personnel, will allow for a more suitable medical detachment for these future smaller, shorter conflicts. It will also provide state-of-the-art equipment to triage, diagnose, and treat military casualties such as fingerstick, card-based laboratory

analyzers, portable ultrasound machines for FAST examinations, small fluid warmers, and rapid fluid infusers. Finally, although this may sound trivial, the FRSS will ensure the confidence the Marines need to "fight the fight." Having medical/surgical care available where needed tells those marines and sailors putting their lives on the line that they are supported.

The issue of "en-route care" must be raised. Transportation of intubated patients or patients requiring intensive monitoring with current transport schemes is not ideal. At Rhino, transportation of the intubated patient required the only corpsman on flight to bag the patient for the duration. This left the remaining nine patients with suboptimal monitoring. If any other individuals were to go for the task of bagging or monitoring, it would have significantly degraded the capability on camp. These corpsman who went with the flights were not able to get back to Rhino for several days. The U.S. Marine Corps with Navy Medicine are now well on the way to developing an en-route care team with appropriate equipment and should be available in short order. Training again is an issue.

The medical planning for current operations lacks trauma expertise. The addition of these trained individuals to medical planning platforms will only give more knowledge and experience to the selection of the appropriate mix of personnel and of particular individuals deployed. It is advised that adding personnel experienced in trauma to future mission medical planning is warranted.

In summary, it is anticipated that many of the future operations by the U.S. Marine Corps will be joint operations with all other services and services from other countries. The support for some of these operations will be from the smaller, mobile surgical teams such as the Forward Resuscitative Surgical Suite teams. The U.S. military medical system would benefit from joint exercises and planning that includes personnel experienced in handling trauma. The creation of a military trauma registry and database is long overdue. Future U.S. military medical care will be faced with problems dealing with logistics, delays in transport to surgical care, and lack of adequate en-route care.

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DISCUSSION

Dr. M. Gage Ochsner, Jr. (Savannah, Georgia): I express my most sincere gratitude and appreciation to Commander Rhee and his co-authors for the personal and professional sacrifices that they made to provide immediate trauma care to the men and women in uniform during this time period of Operation Enduring Freedom. They did this far from home and under extreme and austere conditions. The small number of casualties treated precluded scientific analysis of the types and severity of wounds that they manage.

The critical messages delivered in this manuscript are as follows: First, we haven't learned a thing since the last conflict. Second, we haven't started to solve the problem of medical support for Expeditionary Maneuver Warfare. The lessons learned from the Gulf War, which took place a decade ago, were painfully similar to those we just heard. This supports the observation from several senior veterans from the Vietnam era that the phrase "military lessons learned" is an oxymoron. No standard database for combat casualties existed then, nor does one today. Concerns about adequacy of trauma skills due to minimal exposure to injury in the peacetime—state side's military continues. The lack of dedicated medical support transport personnel requiring forward units to cannibalize precious assets to safely evacuate treated casualties appears to be the same today as it was a decade ago.

Expeditionary Maneuver Warfare is the United States' Marine Corps version of war fighting strategy for the next decade. Instead of large forces advancing, conquering, and controlling large amounts of personnel and real estate, small, highly maneuverable, multiple, fast-moving units, based out of sight over the horizon will perform surgical strikes at key cities and targets and, thus, carry the day. There will be a traditional beach head or staging area where casualties can be collected and treated, therefore providing forward surgical care will be an even more difficult chore than it has been in the past. Commander Rhee has described the United States Navy's current planned solution for treating these patients. Included in those units are extremely valuable medical assets such as surgeons that may well be in harm's way and are probably not going to give Rambo a run for his money. This concept appears to work well in Israel where tertiary care is readily available and less than 1 hour away. Does the same concept work with prolonged evacuation times like those described in this presentation? Why not use war fighters trained as physician extenders to put in chest tubes, surgical airways, and control extremity hemorrhage in these forward teams?

Finally, what remains, at least to me, is the persistence of interservice rivalry and the lack of defined roles. With dwindling medical assets, can we continue to duplicate efforts? I think not.

Again, I would like to thank Commander Rhee and his co-authors for their past and future efforts to serve and care for Americans in uniform.

Dr. Peter Rhee (San Diego, California): Well, Captain Ochsner, I think putting valuable assets in the front, in harms way, is always going to be a major debate. Nonetheless, we see today on the front page of the newspaper that the conflicts are changing. When we put thousands of troops up forward moving very rapidly, are we just going to rely on the troops that are out there and not provide any surgical support? I think that is a problem. As I mentioned, the morale factor that we provide out there is in some ways worth the effort. With the long delays in transport that we're going to see and continue to see, I completely agree with you. I don't necessarily know if putting surgeons and other valuable assets out there is actually going to save lives or not, however getting physician extenders in the field to do medical care when we can't even train our own nurses and corpsmen to do so is always going to be a difficult challenge. Actually, the Marine Corps is even getting away from buddy care and saying the only thing they want to do is self care, because their number one objective is to kill—the more they kill, the less they get killed.

Dr. Steven Shackford (Burlington, Vermont): I see things haven't really changed. When I would get deployed we'd go out and get everything ready only to find out that it hadn't been opened in 15 years. All the latex tubing was cracking and broken, and it was really something, so I see nothing has changed.

When I got out, they had developed a tri-service system of education called the "Combat Casualty Care Corps." It was housed at Camp Bullis. It seemed to me that that was the way we were going to preserve the knowledge that was gleaned from Vietnam. Is the Combat Casualty Care course still active? I think the experience you're getting at L.A. County for the corpsmen and nurses is great, but the converse is that the surgeons also have to understand what it's like to be in the field for prolonged periods of time with no water, no shower, and sleep, or C-rations, as we use to call them, so I think these are both sets of education.

Dr. Peter Rhee (San Diego, California): I can't say for sure. In the Navy there are so many military trauma courses of variety and types that Captain Larry Roberts is working on to condense. At last count, there were approximately 42 courses that train corpsman, nurses, and physicians, but for that specific course, I cannot say. We have a C-4 course that still goes on, and the Uniformed Services still puts on their version of that course (Bush-Master) as well.

Yes, I've been thinking hard about some of the solutions for these problems. I think one of them is if half the people in the audience are willing to put on a plastic white uniform like mine and take little pay, then we would have plenty of trauma surgeons so that they can work in the hospitals and also go into the field. But, we're only about 66% manned. Those are some of the reasons why we can't get the surgeons to go out

in the field and practice. I think these are big issues that we won't overcome in the near future, but I do agree with the other comment as well. We've been saying this for decades, but, as far as the medical corps is concerned, we need to have a purple suited medical corp that can and will play together.

Dr. Stephen F. Flaherty (Fort Bragg, North Carolina): That was a nice presentation. Let me answer Dr. Shackford's question. The Combat Casualty Care course does still exist at Camp Bullis. It begins with the ATLS course, then they proceed into a field activity at Camp Bolus, and that is ongoing.

Dr. Rhee, could you describe for us the composition of your team, the relative specialties, and in what amounts? Also, with the body armor that these guys are wearing, we all know that the majority of their wounds are to the extremities. What is beginning to creep into the lingo out there in the Army is that these wounds are "orthopaedic" wounds. Do you have any sense of how many of these wounds truly needed an orthopaedic surgeon, and how many would you and any other general surgeons out there have been comfortable with?

Dr. Peter Rhee (San Diego, California): The Forward Resuscitative Surgery System is the place is in the forward area, but it will not, in my opinion, ever go past the water buffalo and electricity, because at that point it would become a detriment, as we would need more and more personnel to protect us and give us logistical support. The type of surgery we are designed to do is of absolute necessity—life and limb sparing types of things. We do not do anything else further than that. For example, Lieutenant Commander Bilski who did the neck exploration took out the fragment, controlled the airway, peeked, and shrieked. She noted that there wasn't any vascular injury, so she packed the wound and sent the patient off. The patient ended up getting a very complex flap later on. We will not be doing anything that's not absolutely necessary unless we absolutely have to.

For the Navy, for the FRSS system, we have an eight-personnel crew. For the Army, I know they have 24. The Air Force is different with 5 personnel, including 1 orthopaedic surgeon and so forth. We put two general surgeons on our team, because if you only put one there and he goes down, then the entire team is worthless. The orthopaedic procedures they need to do in the field are none—just stabilize them and send them out. The only orthopedic procedures we are designed to do are wash outs and external fixators. Although 80

to 90% of all operations done on military casualties are orthopaedic, none of them have to be done immediately.

Dr. Slate Wilson (Portland, Oregon): Commander Rhee, could you comment for us on the preparation that we might need for chemical and biological warfare if we go into Iraq?

Dr. Peter Rhee (San Diego, California): The preparation for that is on going and difficult. I think the *U.S.A. Today* article actually covers our current status as well as I can state. We are distributing the Anthrax vaccine as best we can. Some of the other biological things going on are very scary. I don't know exactly what other improvements we could do at this point. Probably the best thing is deterrents and for us to not go in. I don't think anybody is very excited about this one if we go in there.

Dr. Basil A. Pruitt, Jr. (San Antonio, Texas): One of the big advances in the care of combat casualties is said to have occurred in World War II when they bypassed casualty clearing stations and were sent directly to evacuation hospitals. J.M.T. Finney stated that that was because definitive care could be delivered in a more prompt fashion. In light of that, do you feel that there were more casualties who should have been cared for at an evacuation-type hospital facility that was only 400 miles away—and you had absolute air superiority—rather than at your hospital?

I would also ask, as have others, whether, in view of the nature of the casualties treated at your unit, you could have used an orthopaedic surgeon on your surgical team?

Dr. Peter Rhee (closing): Yes, we could have used an orthopaedic surgeon, but it was not necessary at that point, because all of those could have been taken care of at a later time. We were there designed to do life and limb sparing type of procedures only, as mentioned. As far as transporting patients to the definitive site, I agree with that at all times, but training is also an issue at that point because of that one particular incident with a mine injury. The casualty that should have come off the helicopter was the casualty that stepped on the mine. The other two casualties who had superficial injuries got pulled off the aircraft. Then we had to arrange for further transportation to get them out as well, so at any given time, bypassing and going to the highest level of care is always doctrine for the medical community. It's difficult to state whether if the casualty that stepped on the mine was taken off the helicopter whether we could have saved his leg.